Cap Thickness Field Verification Testing: Recommendation to Use AquaGate+PAC™ Thickness Criteria Rather than Criteria Based on % by Volume or Weight

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Introduction

The sediment cap at RM 10.9 is designed to chemically sequester and isolate chemicals of potential concern (COPC) that remain in the undredged sediment underlying the cap. In the event that a COPC becomes mobilized and is subsequently transported upward through the cap via groundwater upwelling, the COPC will be contained within the active layer of the cap. Cap performance, as it relates to chemical sequestration and isolation, is governed by the amount of amendment (i.e., activated carbon) that is present and the distribution of the amendment within the active layer. The effective sorptive capacity of the cap is increased by distributing the active material over a greater thickness. Distribution of the active material in sand to create a thicker sand/active layer decreases concentration gradients (diffusive transport) which increases the residence time through the sand/active layer where sorption is occurring. The sand/active layer performance is increased on the order of more than 2 to 3 times by distributing the active material over a 10-inch thickness compared to only using the same amount of active material without sand. The final design incorporates 10 inches of mixed active material/sand, which CapSim model simulations indicate protects against breakthrough in excess of 250 years. Increasing the active/sand layer thickness by adding more sand to the same amount of active material would increase the cap's performance (i.e., increase the time to breakthrough) even more.

Measurement of Active Layer Material

As discussed above, cap performance is governed by the amount of AquaGate+PAC™ and sand that is present in the sand/active layer. The final design AquaGate+PAC™ content is a minimum average of 30% and a minimum of 25% by volume, which is based on an overall 10-inch-thick active/sand layer thickness. As noted earlier, increasing the amount of sand, while maintaining the necessary amount of AquaGate+PAC™, enhances cap performance even though the % AquaGate+PAC™ decreases. Thus, % AquaGate+PAC™ measurements can be misleading as the % AquaGate+PAC™ may appear to fall below design criteria if the sand thickness exceeds the 10-inch design thickness. Therefore, as the actual placed active/sand layer thickness will frequently vary from the 10-inch

thickness upon which the final design is based, it is necessary to measure the adequacy the active/sand layer composition by a method other than % AquaGate+PAC™.

A better method of evaluating whether sufficient AquaGate+PAC™ was deployed is to directly determine the actual placed AquaGate+PAC™ thickness and compare that value to the design criteria of a minimum average of 3.0 inches and a minimum of 2.5 inches of AquaGate+PAC™. In addition, the active/sand layer thickness is measured to ensure its thickness meets design critieria.

Recommended Daily Field QA/QC Method

The recommended QA/QC method is to determine a daily effective AquaGate+PAC™ thickness by dividing the volume of AquaGate+PAC™ deployed on a given day by the area covered that day. The cap design criteria are a minimum average 30 inches and minimum of 25 inches of AquaGate+PAC™. In addition, the active/sand layer thickness criteria of a minimum average of 10 inches and a minimum of 8 inches must be met.

Results for the area south of the "No Dredge Zone" are presented in Table 1. All areas meet the AquaGate+PAC™ thickness design criteria.

Table 1. Effective Thickness of AquaGate+PAC™ South of the "No Dredge Zone"

DATE	*Estimated Volume of AquaGate+PAC™ Placed (cubic yards)*	*Estimated Area Covered by AquaGate+PAC™ (square feet)*	*Effective AquaGate+PAC™ Thickness* (inches)*
11/13/13	82	9,949	2.68
11/14/13	19	1,845	3.39
11/15/13	109	11,768	3.01
11/16/13	131	12,978	3.28
11/18/13	51	5,076	3.29
11/19/13	130	16,587	2.54
11/20/13	135	17,027	2.57
11/21/13	130	12,653	3.33
11/22/13	166	16,760	3.21

* Example Thickness Calculation for November 16, 2013:

Estimated Volume of AquaGate+PAC™ Placed = 131 cubic yards (3, 545 cubic feet)

Estimated Area Covered = 12,978 square feet

Effective AquaGate+PAC™ Thickness = 3,345 cubic feet / 12,978 square feet
= 0.27 feet
= 3.28 inches